

INTERACTIVE EQUIPMENT DIAGNOSTIC AND ORDER WRITING SYSTEM

FIELD OF INVENTION

The present invention relates generally to interactive computerized systems and methods for obtaining and processing information. More particularly, the present invention pertains to an interactive system and method for receiving information regarding a customer, the equipment, such as an automobile, a tractor and/or trailer, a fork lift, cherry picker or front loader, and the service or repairs it needs, and the processing of this information to generate work and parts orders for the customer, parts. Supplier(s) and mechanic. The invention further pertains to the optional transmission of work completion data to accounting and/or quality control subsystems. While the invention is usable for servicing a variety of equipment, it will be primarily described here in terms of automobiles because the description of this example addresses most, if not all, of the problems relative to a large repair shop for such equipment.

BACKGROUND OF THE INVENTION

Dropping off equipment at a dealership or repair shop for service can be a time-consuming and frustrating activity. Even though such organizations may open as early as 7 a.m. and stay open until 6 p.m., or so to accept equipment for service, these hours are not always long enough to accommodate all customers. Consequently, some customers find it necessary to drop their equipment off during

1 the hours the service centers are closed. With automobiles, for example, the driver
2 usually leaves their keys in an envelope upon which they write the observed
3 problems and request service. Appliances would be put into a cubicle, which locks
4 on closure after the owner has filled out a problem description. In such instances,
5 the complete situation is not always communicated effectively. Even when the repair
6 shop is open, the customer may need to wait quite some time to provide the
7 necessary information to a service manager or other representative, creating further
8 delays. This process is improved using the modern computer technology of this
invention.

The present invention provides an interactive, user-friendly-diagnostic system
for the driver or other equipment deliverer. The customer can answer basic Menu-
driven queries and/or prompts and the system will prepare and transmit to the repair
center a preliminary diagnostic report such as hard starting in the cold - never
happened before. The system is particularly useful for employment outside the
normal operating hours of the repair facility.

Representative of the art is;

17 U.S. Patent No. 5,214,582, issued to Gray, teaches interactive diagnostic
18 systems and methods for automotive vehicles of the type having networks Of
19 sensors and actuators for sensing and actuating various functions in the vehicle and
20 onboard computers for monitoring sensors and controlling the actuators. An external
21 computer is used to control selected actuators independent of the onboard computer
22 and for simulating operation of selected sensors. At the same time, the electronic

1 data entering and exiting the onboard computer is monitored and analyzed by the
2 external computer for trouble shooting purposes.

3 U.S. Patent No. 5,513,107, issued to Gormley of Ford Motor Co., teaches
4 methods and apparatus for controlling operating subsystems of motor vehicles.
5 Diagnostic and maintenance services for the vehicles are provided by monitoring
6 various operating subsystems connected to a vehicle controller and recording
7 diagnostic data. Such data can be periodically communicated to a service center
which determines the service(s) needed and communicates there conclusions back
to the vehicle controller where it is displayed to the vehicle operator.

U.S. Patent No. 5,557,268, issued to Hughes et al. of Exxon, teaches an
automatic vehicle recognition and customer automobile diagnostic system. Each
vehicle includes a transponder that transmits an rf code so that vehicle diagnostic
measurements made upon entry to the service facility can be associated with the
specific vehicle and displayed to the customer in their service area.

U.S. Patent No. 5,058,044, issued to Stewart et al., teaches a system for
automatically identifying vehicles assimilating data from the identified vehicle,
correlating the data with predetermined data and providing a statement of account
for a transaction involving the vehicle. A service record for the vehicle is prepared
by the system for use in connection with such transactions. Data for the service
record is provided primarily by onboard sensors, but may be augmented by data
submitted via an onboard keyboard.

1 U.S. Patent No. 4,602,127, issued to Neely et al., teaches a vehicle
2 diagnostic system comprising a portable communications control station and a
3 remote data processing station. A portable communications controller is connected
4 to a vehicle data terminal to obtain data from the vehicle's onboard computer.

5 U.S. Patents Nos. 4,975,847 and 5,065,023, both issued to Abe et al., teach
6 motor vehicle diagnosis systems.

7 U.S. Patent No. 5,541,840, issued to Gurne et al. of Chrysler Corporation,
8 teaches a hand-held automotive diagnostic service tool which can operate with a
master station to monitor, display, and process vehicle data and diagnose fault
conditions. Service manual pages can be displayed and parts ordered on-line.

U.S. Patent No. 5,533,093 teaches an automated troubleshooting mechanism
incorporated into portable test and communications equipment for telephone lines.
Work order manager software is employed.

U.S. Patent No. 4,916,441 teaches a hand-held pocket terminal having a
display screen and bar code reader for use in conjunction with patient medical care.

Various aspects of interactive CRT touch panel displays are taught by U.S.
17 Patent Nos. 4,449,186 (to Kelly et al.), 5,404,443 (to Hirata), 5,488,575 (to
18 Danielson et al.), 5,499,707 (to Steury) 1 5,537,315 (to Mitcham) and 5,539,429
19 (to Yano et al.). Such touch panels have been found useful in facilitating
20 communications in a variety of customer service contexts.

21 The Super Advisor System marketed by Automatic Data Processing, Inc., of
22 Hoffman Estates, Illinois, USA, allows Service advisors to use a hand-held, wireless

1 pen pad computer system to select or decline maintenance items displayed on the
2 computer's screen and to describe vehicular problems via a series of checklists and
3 multiple-choice questions. The system also provides customer appointment
4 management, etc., using Microsoft Windows®.

5 One aspect of the present equipment service invention is to provide an
6 efficient system and process for obtaining, recording and utilizing appropriate
7 information about a vehicle and its required service from a customer.

Another aspect of the invention is to provide a system for obtaining such
information without the need for the presence of a representative of the repair shop.

Yet another aspect of the invention is to provide a complete, concise, and
readable repair/service order for the mechanic, parts suppliers, and customer.

These and other objectives are fulfilled by preprogrammed interactive
computer systems for obtaining vehicle information, symptoms and requests from a
customer, and developing work and parts orders. The system includes:

interactive input, display, computing and storage mechanisms for querying the
customer, receiving inputs of information, and storing the provided information;

17 preprogrammed central computer processing unit(s) for ordering successive
18 presentations of appropriate queries for the customer via the display means;

19 a compiler to summarize the inputs received and process the summary to
20 generate a work and/or parts order; and at least one printer to print the work order
21 for both the customer and mechanic, billing records, and reminders to the vehicle
22 service and other personnel for future services.

1 Optionally, an input mechanism can be provided to transmit data upon
2 completion of the work to an accounting module or subsystem to facilitate
3 preparation of the bill and notification of the customer by the accounting department.
4 Such data can also be transmitted to a quality control subsystem.

5 Further input and display mechanisms are provided for the mechanic to check
6 and provide status information about the automobile's current service program. A
7 data bank is provided to receive and maintain current status information on work
8 assignments being performed for customers and cars. Interactive communication
9 units are provided to originate and receive calls to and from customers regarding the
10 status of the work assignments on their cars. Interactive communication units are
11 also provided to initiate and execute orders for service, supplies, and parts from
12 dealer stock or external providers.

13 Other components of the system include interactive computer monitor screens
14 which identify relevant portions of the vehicle, the locations therein, and symptoms.
15 Input mechanisms for the system include touch-activating monitor screens and
16 keyboards. A database of scheduled and unscheduled periodic maintenance tasks
17 for various types of vehicles serviced can be linked to the pertinent query screens.
18 This database information can be provided at a distance by use of the Internet or
19 locally through computer memory. Programmed query sets include the categories of
20 engine/drivability, noise/vibrations, transmission, 2 and 4-wheel or more drive,
21 heater/AC, brakes, steering/suspension, power accessories/electrical, and
22 miscellaneous other services.

1 Further, an interactive computerized process is provided for receiving
2 customer inputs for developing work orders for automobile repair and maintenance.
3 This is accomplished by steps including!

4 querying the customer and receiving inputs regarding the customer and
5 automobile ID via computer input and output systems using Programmed sets of
6 questions regarding specified vehicle systems and categories regarding the
7 maintenance and/or repairs;

selecting the services which are requested and/or needed, including
investigative work;

printing, storing and displaying work orders including the provided customer
and vehicle ID and assigned services for both the customer and the assigned
mechanics; and

printing reminders for use by the equipment owner or equipment service
personnel relative to prior history, dates or usage mileposts requiring further service
or bar-coded information for future reference.

16 17 **BRIEF DESCRIPTION OF THE DRAWINGS**

18 Like reference characters designate corresponding parts in the several views.

19 FIG. 1 provides a block diagram of the system, as it would be used at a typical
20 automobile dealership or repair shop.

21 FIG. 2 is a master flow sheet illustrating the organization and operation of the
22 system.

1 FIG. 3 illustrates a "customer service process" of using the system.

2 FIGS. 4-11 are queries for each of the subcategories of FIG. 2.

3 FIG. 4 is a flow sheet for the category 1, "Engine Drivability", problems.

4 FIG. 5 is a flow sheet for the category 2, "Noises/Vibrations", problems.

5 FIG. 6 is a typical flow sheet for the category 3, "Automatic/Manual/4 Wheel
6 Drive", problems.

7 FIG. 7 is a flow sheet for category 4, "Heating/AC", problems.

8 FIG. 8 is a flow sheet for category 5, "Brakes", problems.

FIG. 9 is a flow sheet for category 6, "Steering/suspension", problems.

FIG. 10 is a flow sheet for category 7, "Power Accessories/Electrical",
problems.

FIG. 11 is a flow sheet for the category 8, "Other Services".

FIGS. 12-21R are illustrative of computer screens useful for obtaining the
information needed under categories 1-8.

FIG. 12A to 12G illustrate selected computer monitor screens for "Introductory
Information."

7 FIG. 13 illustrates a computer monitor screen for the selection of pertinent
18 categories.

19 FIGS. 14A to 14D illustrate computer monitor screens for the "subcategory 1"
20 program.

21 FIGS. 15A to 15E illustrate computer monitor screens for the "subcategory 2"
22 program.

1 FIGS. 16A to 16E illustrate selected computer monitor screens for the
2 "subcategory 3" program.

3 FIGS. 17A to 17E illustrate selected computer monitor screens for the
4 "subcategory 4" program.

5 FIGS. 18A to 18D illustrate selected computer monitor screens for the
6 "subcategory 5" program.

7 FIGS. 19A to 19D illustrate selected computer monitor screens for the
 "subcategory 6" program.

 FIGS. 20A to 20F illustrate selected computer monitor screens for the
 "subcategory 7" program.

 FIGS. 21A to 21S illustrate selected computer screens for the "subcategory 8"
 program.

 FIGS. 22A to 22C illustrate selected computer screens for the "Additional
Services" program.

 FIG. 23 illustrates a computer screen for addressing "Additional Problems."

 FIG. 24 illustrates a screen for "Unscheduled Services."

17 FIGS. 25A-26B illustrates screens asking for a review the "Repair Order."

18 FIG. 26 illustrates an "Estimated Repair Costs" screen.

19 FIG. 27 illustrates a "Designation of the Service Advisor and Cost Estimate"
20 screen.

21 FIG. 28 illustrates a screen authorizing the repair work and acknowledges the
22 criteria under which the repair is to be done.

1 FIG. 29 is illustrative of a screen providing instructions for the deposition of
2 keys into a lockbox.

3 FIG. 30 illustrates a screen allowing a designation of whether the customer
4 wishes to "Wait, Drop off the Car, or obtain a Loaner."

5 FIGS. 31A and 31B illustrate screens relating to the acceptance of the
6 finished repair order.

7 FIG. 32 depicts the representative print-out of "Repair Order."

FIG. 33 is a portion of a typical flowsheet for the repair of other vehicles and
equipment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1 and 2 provide an overview of the systems and methods of the
invention. FIG. 1 is a system overview of the invention. A customer brings an
automobile to the repair center where customer interacts with customer interview
terminal screen 10. This console can include a portable personal computer or, at
least, a freestanding terminal serving a master computer. It comprises input means
and interactive display means, preferably a touch-active CRT screen such as
disclosed in U.S. Patents Nos. 4,449,186; 5,404,443; 5,488,575; 5,499,707;
5,537,315 and 5,539,429 incorporated herein by reference. Such touch-active
screens preferably incorporate audio output means, as disclosed in U.S. Patent No.
4,449,186. The system is designed so that the hardware and software cooperate to
provide convenient means for the customer to provide the necessary information.

1 Preferably, most information will be provided via the touch-active screen in response
2 to a menu-driven series of queries or prompts, Some of the input information (i.e.,
3 vehicle and customer ID, credit card payment information, and the like) can be
4 provided by inserting to the card reader 20 a credit card, or other identity card issued
5 by the repair center to minimize effort on the part of the customer and errors as well.
6 Such cards can be used to unlock and provide access to the console and other input
7 devices to minimize vandalism or other unauthorized activities, Alternatively,
8 systems can be used which automatically sense the vehicle's ID and/or the condition
of the vehicle systems 40, see e.g., U.S. Patent No. 5,058,044. To augment the
preferred touch-active screens, a standard or simplified alphanumeric keyboard 30
can be provided, and optionally provisions can be made for the customer to dictate
into the input system using devices such as the voice-activated system disclosed in
U.S. Patent no. 5,586,037.

In addition to the Customer's direct input of ID data, observed symptoms, and
requests at this intake transaction, customer may be assisted by a service advisor or
other representative of the repair center. Such representatives may enter
17 information at the console 10, and/or use a hand-held device such as disclosed
18 above. Optionally, readings may be taken from the vehicle's onboard computer 50
19 at this point using d hand-held unit or other computerized monitor. In this way, the
20 error codes from the onboard computer can be read, analyzed, and considered in
21 writing up the service order. This will normally be available only if the customer is
22 willing to wait and there is a repair center representative available to take the

1 readings unless an automatic sensor system is used as in U.S. Patent No.
2 5,557,268. A service advisor may introduce information into the system via console
3 10, either during the customer's intake transaction or thereafter. Preferably, the
4 service advisor will employ a hand-held unit incorporating the functions of console
5 10.

6 The console displays menus, queries, prompts and input/output data on the
7 CRT screen, and upon command or completion of the transaction prints out
materials via printer 40 for the customer's use,

The information inputs all enter a central processing unit (CPU) 70 component
of a computer where they are analyzed and correlated. The system may query the
customer further to develop the input information fully before closing the transaction.
When the initial information is obtained, the system prepares a service order, if the
needed service and/or repairs are clear. If more information is needed to determine
the Service required, the system can print out and display a proposed service order
containing queries for the mechanic and/or service advisor to analyze. The service
mission is subject to change after readings have been taken from the vehicle's
onboard computer.

18 A finished service order will be transmitted to mechanic via printer 90 and/or
19 console, which displays the order on a CRT screen. Using similar input means to
20 those described for console 10, the mechanic can submit information to modify the
21 service order, query the service advisor as to what work is approved, and advise the
22 system when the job is completed or delayed. Such inputs will be transmitted to

1 CPU 70 which stores and processes them, Events including job completion or delay
2 are transmitted via suitable communications media, such as the telephone, facsimile,
3 or e-mail, to the customer using customer notification programs. Additionally, in the
4 process of the job, the CPU can be used to optionally identify and order materials,
5 spare parts and the like for the service using ordering program.

6 FIG. 2 is a master flow sheet illustrating the operation of the computerized
7 process outlined in FIG. 1. To initiate the intake process, the customer approaches
8 terminal 100. Information input can be by scanner, e.g., FIGS. 12A and 12B, or
other means, e.g., a typewriter. Preferably, the information is generally input by use
of a touch screen. Where a numeric input is needed, a keypad will appear, e.g., 12A
and 12B. Where alphabetic and numeric information is needed, an alphanumeric
keypad will appear, e.g., 12C. Specific information is input into the computer of a
preferred hand-held unit by stylus pressure on a square, e.g., FIG 13E; a dot, e.g.,
13F, a circle, e.g., 13G. Basic ID, and, where selected, credit card information can
be provided via an ID card reader 105 and/or submitted via touch-active screen or
keyboard. The information provided appears on display 110 which provides
17 correction prompts or queries. For example, if the current vehicle mileage and
18 phone contact information are not provided initially, they can be submitted upon
19 request as at 115 and 120. When the necessary intake information is provided, the
20 display shifts to the main menu 125 which offers multiple choices as well as a "Help"
21 function. In FIG. 2, the main menu categories include the Engine/drivability (1),
22 Noise/vibrations (2), Automatic/manual/4-wheel Drive Transmission (3), Heater/AC

1 (4), Brakes (5), Steering/suspension (6) Power accessories/electrical (7), and Other
2 services (8) subcategories. These categories are supplemented (See Fig. 32) for
3 vehicles more complex than automobiles, e.g., a Peterbilt truck, and vehicle-based
4 equipment, e.g., a cherry picker and a front loader. Each of these menu choices
5 leads to subroutines containing multiple menu choices to guide the customer through
6 an interrogation process which will identify the problems to be corrected and/or
7 routine services to be performed. Exemplary flow diagrams for these subcategories
are provided in subsequent figures discussed below. Upon completion of any of the
subroutines 1 through 8, the display shifts to a "General Questions" subroutine 130
which queries the customer as to how often the problem occurs and similar
questions. After responding to these queries, the customer is queried as to whether
there are additional vehicle problems 135; if "yes", the program reverts to the main
menu for further choices. Selection of the "other services" menu 140 provides
options for choosing various maintenance services as well as a "Help" option which
refers the customer to the service advisor as shown at 145.

Upon completion of the interrogation via the categorical subroutines, the
customer is automatically transferred to "Additional Services" subroutine 150, which
18 offers further choices discussed below for routine service operations and the like.
19 When the customer has finished with this subroutine, customer is transferred to an
20 additional services menu 150 which offers additional service options. Once the
21 customer exits this menu, customer is transferred to subroutine 155 which uses
22 Boolean and other processing logic to provide a compilation of the symptoms and

1 requested service items and displays the compilation along with a menu of additional
2 accessories or services which can be purchased. Following this, subroutine 160
3 provides a cost estimate of any requested maintenance services, and subroutine
4 165 provides a cost estimate of repair costs and pickup time. The repair/work order
5 is presented by subroutine 170, and the customer's electronic signature is captured.
6 On signature of the repair order, instructions for leaving the key(s) in a secure
7 depository are shown at 173. Subroutine 175 then queries whether the customer will
8 wait for the vehicle, drop it off, or request a loaner vehicle. This subroutine also
queries the customer's requests with regard to the disposition of the used parts.
Finally, the finished repair estimate is displayed and printed out for both the
customer, service advisor and the mechanic, at 180.

FIG. 3 illustrates a customer's interaction with the system. As in FIG. 2, a
customer interacts with blocks 300, 305, 310, 315, 320, and is transferred to main
menu 325. Category 1 Engine/drivability is selected by the customer at 330 and
menus are presented as in FIG. 4. The customer is exposed to a succession of
computer monitor screens in the course of selecting from the menu, as illustrated in
FIGS. 12A to 12G. As shown in FIG. 3, the customer selects the "Symptoms when
starting category at 335, and thereafter is called upon to describe the symptoms at
340 and when they occur at 345. After the selection of the latter, the system
transfers to the "General questions", subroutine 350. After this question is
answered, the system transfers to the "Additional vehicle problems", subroutine 355.
In this case, the customer selects "NO", and is transferred to the "additional

1 services" menu 360. Since the customer chooses no additional services, the system
2 analyzes the symptoms and any requested maintenance services at 365 and
3 presents the customer with a menu of additional merchandise and services which
4 can be purchased. Subroutine 370 presents the customer with the estimated
5 maintenance costs (if any), and subroutine 375 presents a statement of estimated
6 repair costs and pickup time. The system then captures the customer's signature
7 380, queries as to whether customer will wait or drop off the vehicle 385 with the
repair organization, whether a loaner is required, and whether parts are to be
returned as shown in block 385. Finally, the finished repair order is displayed and
printed for both customer and mechanic at 390.

FIG. 4 illustrates the operation of the "Engine/drivability" menu (category 1).
The customer is initially presented with a choice as to describing symptoms which
occur when starting or driving, or "Other symptoms". Given any of these three
choices, the customer is asked to describe the nature of the symptoms, then queried
to describe when the symptoms occur. Optionally, inputs from the service computer
can be provided at this point to provide further information on the nature of the
symptoms and when they occur. After these questions are answered, the subroutine
transitions to a "General Questions" subroutine to describe how often the symptoms
occur. From General Questions, the customer selects whether or not there are
Additional Vehicle Problems. If none, customer proceeds to Additional Services; if
"yes" is answered, customer is returned to the Main Menu to make another choice,

1 FIG. 5 illustrates the menu choices for "Noise/vibrations" (Category 2). The
2 initial menu allows the customer to select noises or vibrations alone or a combination
3 of both, Whatever the choice, the customer will be queried as to what the nature of
4 the symptoms are, when they occur and where the symptom occurs. Input from the
5 service computer can be provided to assist in the analysis. Finally, the customer is
6 queried as to "how often" the symptoms occur. At this point, the computer advances
7 to "Additional Vehicles Problems" 135.

8 FIG. 6. Illustrates menu choices for a "Automatic/manual/4-wheel drive"
9 transmission check (Category 3). The initial menu requires selection as to automatic
10 or manual transmissions or the 4-wheel drive. Once a selection is made, the
11 customer is queried as to the nature of the symptoms and when they occur. These
12 questions answered, the customer is queried as to how often the symptoms occur.
13 After all these questions are answered for a subcategory, the customer is queried as
14 to whether there are problems in another subcategory. If not, the system moves to
15 the closing sequence. If the customer indicates that there are problems in another
16 subcategory, (e.g., problems with the 4-wheel drive in addition to the transmission),
17 the computer returns to the main menu 125 for another selection.

18 FIG. 7 illustrates the operation of the menu for "Heating/Air Conditioning"
19 (Category 4). The initial menu selections are for symptoms of heating, air
20 conditioning or automatic temperature control. Once a subcategory is selected, the
21 customer is again called upon to describe the nature of the symptoms and when they
22 occur. These questions answered, the system transitions to "General Questions"

1 including how often the symptoms occur. After these questions are answered, the
2 customer is called upon to declare whether there are additional problems in other
3 subcategories. If not, the closing sequence is actuated. If so, customer is returned
4 to the menu 125 to make another selection.

5 FIG. 8 illustrates the menu choices for "Brakes" (Category 5). The initial
6 menu selections are for conventional brakes, anti-lock brake systems, or
7 combinations of both. As in the other categories, the customer is called upon to
8 describe the nature of the symptoms, when they occur, and how often they occur
before returning to the main menu or going through the closing sequence.

FIG. 9 illustrates the menu choices for "Steering/Suspension" (Category 6).
The initial menu choices are for steering or suspension problems, and after making a
selection, the customer is called upon to describe the nature of the symptoms, when
they occur, and how often they occur, After these questions are answered, the
customer is queried whether there are any symptoms in the other subcategory (e.g.,
suspension in addition to steering). If not, customer is returned to the main menu or
passed through the closing sequence.

17 FIG. 10 illustrates the menu choices for "Power Accessories/Electrical"
18 (Category 7). The initial menu choices are for electrically operated components and
19 power accessories, and once a selection is made, the customer is queried as to the
20 nature of the symptoms, when they occur, and where they occur. Once these
21 questions are answered, the customer is queried as to how often the symptoms
22 occur. Upon completion of these questions, the customer is queried as to whether

1 symptoms exist in another subcategory. If not, the customer is returned to the main
2 menu or to the closing sequence.

3 FIG. 11 illustrates the menu operation for "Other" problems (Category 8), The
4 initial menu choices are scheduled and unscheduled maintenance, i.e. maintenance
5 which is conducted at predetermined total mileage figures or at periodic mileage/time
6 intervals. Once selections are made for any required maintenance in these
7 subcategories, the system queries the customer regarding "Additional Vehicle
Problems". Subcategories 3 and 4 provide menu choices regarding problems with
the vehicle exterior and interior. Having selected one of these subcategories, the
customer is queried as to the nature of the symptoms, when they occur, and where
they occur before being asked general questions including how often they occur.
When queries and answers for each subcategory are completed, the customer is
queried as to whether problems/symptoms exist in other subcategories. If so,
customer is returned to the main menu for another selection or progresses through
closing sequence. Subcategory 5 covers special orders or parts and recall notice
items. Subcategory 6 deals with new or used-car problems. In subcategory 7,
"General Symptoms", the customer is again called upon to describe the nature of the
18 symptoms, when they occur, and where they occur then how often the symptoms
19 occur.

20 FIGS. 12A and 12B illustrate computer screens which relate to information
21 obtained by optic, magnetic or rf (including microwave) scanning. FIGS. 12C-12D
22 illustrate screens which enable the customer to input personal information. FIGS.

1 12E and 12F are illustrative of screens enabling the customer to input "Mileage" by
2 pressing a "change" designator to bring up a numeric keypad. FIG. 12G similarly
3 enables the customer to enter a telephone number for contact during the period the
4 car is in the shop. An illustrative keypad screen is omitted.

5 FIG. 13 illustrates screens for the selection of one or more repair categories.
6 Category 1, "Engine/Drivability" has been selected as indicated by the outline
7 around that category.

FIGS. 14A to 14E illustrate computer monitor screens for the "Category 1"
program. FIG. 14A identifies the category and asks for the selection of "Symptoms."
FIG. 14B illustrates a screen for "Symptoms when starting." FIG. 14C illustrates the
screen for "When do you notice it", i.e., the questions about the nature and
frequency of the symptoms. FIG 14D illustrates the screen querying the customer
regarding "Symptoms when driving".

FIGS. 15A to 15E illustrate selected computer monitor screens for "Noises
and Vibrations", the Category 2, program. FIG. 15A illustrates a computer screen
representing the selection of the "Noise or Vibration" category, including selections
17 for noises and/or vibrations. FIG. 15B illustrates a screen representing the selection
18 of the "Noise information" subcategory. FIG. 15C illustrates the screen presenting
19 the query "Where is it coming from?" via a diagram. FIG. 15D illustrates a screen
20 querying "When does it happen" containing generic questions pertaining to noises
21 and/or vibrations. FIG. 15E illustrates the screen requiring the selection of
22 vibrational categories. "Shudder" has been selected.

1 FIGS. 16A to 16E illustrate selected computer monitor screens for a Category
2 3, "Automatic/Manual/4 Wheel Drive Transmission" program.

3 FIG. 16A illustrates the computer screen for the category of "Transmission"
4 information, offering choices for automatic or manual transmissions or an exemplary
5 4-wheel drive. FIG. 16B illustrates the screen for the "Automatic transmission"
6 subcategory offering choices as to types of symptoms observed. FIG. 16C illustrates
7 the screen for the "Manual transmission" subcategory, offering choices of various
 symptoms observed. FIG. 16D illustrates a screen for "4-wheel drive transmissions"
 subcategory offering choices as to various symptoms observed. FIG. 16E illustrates
 a screen querying 'When does it happen', with a set of generic questions applicable
 to any of the subcategories.

 FIGS. 17A to 17E illustrate selected computer monitor screens for the
 category 4, "Heater/AC" program. FIG. 17A illustrates the computer screen for
 defining the Heating or Air Conditioning problem. FIG. 17B illustrates a screen for
 the 'Heating' category. FIG. 17C illustrates a screen for the "Air Conditioning"
 category. FIG. 17D illustrates a screen for the automatic temperature control
17 system. FIG. 17E illustrates a screen providing questions as to "When does it
18 happen."

19 FIGS. 18A to 18D illustrate selected computer monitor screens for the
20 category 5 "Brakes" program. FIG. 18A illustrates a computer screen for defining the
21 particular brake system. FIG. 18B illustrates a screen for defining the problem with a
22 conventional braking system. FIG. 18C illustrates a screen for defining problems

1 with regard to an anti-lock braking system. FIG. 18D illustrates a screen querying
2 "When does it happen."

3 FIGS. 19A to 19D illustrate selected computer monitor screens for the
4 category 6, "Steering and Suspension" program. FIG. 19A illustrates a computer
5 screen for defining whether the problem relates to steering or suspension. FIG. 19B
6 illustrates the screen for the "Steering information" subcategory including questions
7 regarding various symptoms observed with regard to the steering. FIG. 19C
illustrates the screen for the "suspension" subcategory, including questions
regarding various symptoms observed. FIG. 19D illustrates the screen for "When
does it happen" including questions regarding the operating modes and speed when
either steering or suspension symptoms occur.

FIGS. 20A to 20F illustrate selected computer monitor screens for the
"Electrical" program. FIG. 20A illustrates a computer screen offering choices of
problems connected with "electrically operated components" or "power accessories".
FIG. 20B illustrates a screen which includes questions regarding the specific
components requiring service. FIG. 20C illustrates a screen including questions
17 regarding "Power accessories" where the symptoms are observed. FIG. 20D
18 illustrates a screen for narrowing the search terms. FIG. 20E illustrates the screen
19 for "When does it happen". FIG 20F illustrates a screen for identifying the area
20 where the problem is located.

21 FIGS. 21A to 21L1 illustrate selected computer screens for the "Other
22 services" program. FIG. 21A illustrates a screen for "Other services available"

1 offering menu choices for scheduled and unscheduled maintenance, vehicle exterior
2 and interior, special order parts and recall notices, new- or used-car internal and
3 general symptoms. FIG. 21B illustrates a screen for "Unscheduled maintenance"
4 and FIG. 21C illustrates a screen for "Vehicle exterior" subcategory including
5 questions regarding the area(s) in which the problem is occurring. FIG 21D provides
6 problem location selections. FIG 21E illustrates a screen requesting information on
7 the problem description. The FIG. 21F illustrates a screen for locating a problem on
the vehicle exterior via a diagram. FIG. 21G illustrates a computer screen for the
'Vehicle interior' subcategory, including questions regarding the area where the
problem is occurring. FIG. 21H illustrates a screen for the "Problem location"
subcategory of 'Vehicle interior lighting'. FIG. 21I is illustrative of a screen for
locating problems via a diagram. FIG. 21J illustrates a screen for describing the
problem in the vehicle interior. FIG 21K illustrates a screen for information regarding
a special order or recall notice. FIG. 21L illustrates the screen for a "new car" or
"used car" internal repair order. FIGS. 21M – 21S illustrate screens for identifying
things the customer sees, hears, smells and feels under the "help" category 140 of
FIG. 2 and asks "When" and "Where."

18 FIGS. 22A to 22D illustrate selected computer screens for "General
19 Questions, Other Symptoms and Return Problems."

20 FIG. 23A illustrates an "Additional problems" screen.

21 FIG. 24 illustrates a screen for selecting "Unscheduled services" and includes
22 prices for those services.

1 FIGS. 25A and 25B are screens requesting that the customer review the
2 previously input material.

3 FIGS. 26 and 27 illustrate screens for providing an estimate of cost and pick-
4 up time.

5 FIG. 28 illustrates a screen for acknowledgment and capture of customer
6 signature. This corresponds to block 170 on FIG. 2.

7 FIG. 29 illustrates a screen instructing the customer to deposit the vehicle
keys in an appropriate lockbox.

 FIG. 30 illustrates a screen for selection of "wait", "drop off", or a "loaner."

 FIGS 31A and 31B illustrate "Repair order acceptance" screens. This
corresponds to block 180 of FIG. 2.

 FIG. 32 illustrates the "Repair order generated" screen including the captured
customer signature.

 FIG. 33 illustrates the additional categories 9 and 10 of a Master Flow Sheet
extending FIG. 2 for various types of vehicular equipment.

17 **GENERAL DESCRIPTION OF THE INVENTION**

18 Various combinations of commercially available computer hardware can be
19 used to assemble the systems of the invention. Computer support can range from a
20 single personal computer or microcomputer to a master computer with multiple
21 terminals. Portable or hand-held terminals or computers can be used to facilitate the
22 collection and transmission of data. The computer support mechanisms preferably

1 include a central processing unit, at least one compiler, data storage devices
2 including disk drives and the like, at least one monitor with display screen, a modem,
3 an interactive media device and input/output mechanisms. The computer system is
4 configured, as required, by the particular programs to be run with capacities and
5 rates suitable to provide reasonable response times.

6 Input mechanisms can include conventional keyboards and/or keypads,
7 interactive touch screens, and screens with icons responsive to a "mouse", optical
and magnetic readers, and data input ports. Preferably the input mechanisms
include touch-active display screens as discussed in detail below. Such screens
permit interaction between a user and the computer in response to the user's
touching the screen with an object such as a finger or a pointing device. As
disclosed in U.S. Patent No. 5,537,315, such pointing devices can include a light
pen, sonic pen, voltage pencil, stick, or wand. Other input mechanisms to the
system, if not directly to the computer, will include conventional credit card readers
for receiving data about the customer and/or vehicle to be serviced, plus payment
information such as credit card numbers. One suitable credit card reader is
disclosed in U.S. Patent No. 4,449,186, column 1. Optionally, the input mechanisms
can include a voice-activated system, such as a digitized voice recognition system
for receiving user input, such as those pioneered by Dragon Systems, Inc., San
Rafael, California.

21 The computer support mechanisms preferably include at least one hand-held
22 or portable terminal which permits data to be input to the system via a keypad or

1 keyboard or equivalent device. This will permit a service advisor and/or mechanic to
2 receive and input data conveniently from the vehicle. Such terminals have become
3 commonly available and can be designed or purchased and modified to interface
4 with the system. A representative example of such terminals is found in U.S. Patent
5 No. 5,468,575.

6 Since most contemporary automotive vehicles include onboard computers
7 which receive information from sensors, control various systems via actuators, and
record various failures of equipment, input mechanisms for the system should
include mechanisms for reading and analyzing data from such onboard computers.
Any suitable mechanism can be used which allows such data to be read, analyzed,
and input to the computer of the system. One example is the "hand-held automotive
diagnostic service tool", of U.S. Patent No. 5,541,840, which is incorporated herein
by reference. As disclosed in U.S. Patent No. 4,602,127, many modern vehicles
include mechanisms for obtaining direct access to the data of such onboard
computers on a real-time basis. Inputs to the system can also be provided by
automatic vehicle recognition and diagnostic systems such as those disclosed in
17 U.S. Patent No. 5,557,268.

18 Output mechanisms can include display mechanisms, such as the CRT
19 display screens of computer monitors, printers, and program-actuated facsimile,
20 credit checking devices, and/or telephone devices. The printer(s) can be any
21 suitable unit(s) selected from commercially available models such as laser or ink jet
22 printers.

1 Computer programs or software subsystems or modules are used to carry out
2 various tasks for which the systems are employed. Many of these subsystems can
3 be obtained or modified from existing commercial programs. In any case, the
4 required programs can readily be provided by those of ordinary skill in the art in view
5 of the teachings herein. For instance, accounting and billing programs are readily
6 available and can be obtained or modified to provide a statement of account for
services performed. Programs for receiving and analyzing the data stored in vehicle
onboard computers are also available. However, the most important part of the
diagnostic process will still generally be the analysis by the mechanic and/or service
manager of the information provided by such programs and the vehicle driver.
Service order-writing programs are generally available; see, e.g., U.S. Patent No.
5,058,044,

Programs to generate and/or access a service record for the vehicle(s)
serviced are also available. Technical library or database programs can be used to
provide access to scheduled and unscheduled maintenance operations, service and
parts manuals for the mechanic as well as the customer. Programs for identifying
and ordering parts are also available. However, such programs will generally be
tailored or prepared especially for users of the particular systems of the invention.

The figures provide an exemplary mechanism for obtaining the vehicle driver's
input. They do not include a listing of all possible options with respect to
automobiles. The additional categories 9 for "Mechanical" and 10 for "Hydraulic or
Pneumatic" systems will include the "What", "Where", and "When" questions of the

